Etheridge, jun., with those referring to Australasia. The important department of Physical Geology has been undertaken by Prof. Green, and those of Mineralogy and Petrology by Prof. Rudler; while the science of Palæontology has been equally well cared for—Mr. Miall taking the papers referring to the Vertebrata, Prof. Nicholson those relating to the Invertebrata, and Mr. Carruthers those on Fossil Plants. Besides the sub-editors, a number of other contributors have given their assistance in connection with this important work.

When we reflect on the immense body of literature on the different branches of the natural sciences which is yearly published, we shall find good reason to be satisfied with the approximately complete character already attained by this, the first volume of the "Geological Record." It is only necessary to refer to the yearly increasing activity of our great scientific societies, the continual formation of new local associations and field-clubs (whether connected with particular districts or with our Universities and public schools), most of which publish their own transactions, to show the difficulty of making a complete catalogue even of the scientific publications which appear yearly in the British Islands alone. But when we add to these the prolific publications of the different State surveys and the numerous scientific institutions of the United States and of our own colonies and dependencies; when we bear in mind the scientific activity exhibited by the French, German, and Italian speaking populations of Europe, and the books and journals written in languages, which of course few scientific men are able to read, such as the Russian, Danish, Dutch, Scandinavian, Hungarian, Bohemian, Serbian, &c.; and when we recollect that geological memoirs are published even in Japan and Tahiti!—we may have some idea of the magnitude and difficulty of the task with which the conductors of the "Geological Record" have to grapple.

In illustration of the energy which has been brought to bear upon this task, we may mention that the first volume of the "Geological Record" extends to nearly 400 pages; that the journals of which the contents, so far as they relate to geology, have been given in abstract, number nearly 200; and that the separate entries of books, memoirs, and maps exceed 2,000.

Henceforward, the yearly volumes of the "Geological Record" must find a place on the shelves of every scientific library; and in congratulating the editor on the manner in which he has surmounted the first and greatest difficulties of his arduous undertaking, we find only one cause for complaint. So far as the title-page shows, no arrangements have been made with agents residing abroad for the circulation of the work in America, the colonies, and on the Continent. We are persuaded, so very general is the use of the English language among the scientific men of all parts of the world, that so soon as this omission is remedied, the foreign circulation of the "Geological Record" will equal or even exceed that which it already has at home; while most valuable aid will be given in the preparation of the future volumes of the work by the secretaries of foreign societies and the editors of Continental and American journals sending copies of their publications, immediately that they appear, to the conductors of this important work of reference.

J. W. J.

OUR BOOK SHELF

Lessons on Rigid Dynamics. By the Rev. G. Pirie, M.A. (London: Macmillan and Co., 1875.)

THIS work treats of the geometry of motion, D'Alembert's principle, reduction of the expressions for the effective forces, moments and products of inertia, energy, precessional motion, and certain differential equations which occur in treating of the subject of Rigid Dynamics. There is an excellent selection of exercises, many of which are worked out, and the answers are in many cases accompanied by useful hints. The book appears to us to be in every respect an admirable one, and to be a good introduction to the study of this difficult branch of natural philosophy. We agree with Mr. Pirie in thinking that much of the difficulty students find in this subject arises from the explanations which are given in the ordinary text-books being for the most part brief and often, in consequence, obscure. We believe the author's hope that his book may be useful not only to students of natural philosophy, but also to engineers, is likely to be realised. We cordially recommend the book.

The Secret of the Circle, its Area Ascertained. By Alick Carrick. (London: H. Sotheran and Co. Chiswick Press, 1876.)

ONE more contribution to the long list of works on the Circle, put forth with the usual assurance that now the question must be set at rest. "Dedicated with great deference to the different schools of learning and to the intelligence of the public generally in this and other countries, in the confident hope and full belief that the truth pointed out in these pages will soon be acknowledged." There is a prefatory notice taking us down to page 16 (there are 48 pages in the pamphlet), from which we learn that the author's name is an assumed one, and that he is now dead. "Introductory" takes us to page 39. "The Secret of the Circle, its Area Ascertained," occupies the rest of the book. The Rule given is, "Diameter × radius + four-sevenths" (*sic*), hence our friend π is equated to $\frac{22}{7}$. There are ten figures, some pretty to look at, but there is a dearth of letters, and it is often hard to make out what parts are intended in the demonstration. There is much that is true and not new; for instance, that the inscribed dodecagon is equal to the inscribed square and half that square; what is new is not proved to be true. Thus to get the result, the circular segment bounded by the side of the dodecagon ought to be for his purpose $\frac{1}{84}$ (radius)^2, and this is not shown on pp. 44, 45, for it is not proved there that Q contains the nine segments which it is said to contain. Hence we are led to say that the truth about the Circle is *not* to be found *here*.

Australian Heroes. By Charles H. Eden. (Society for Promoting Christian Knowledge).

MR. EDEN has written a very interesting book. As might be surmised from the title, he has brought into prominence the adventures of the explorers of Australia rather than the results of their explorations. Australia is unlike almost any other country which has been the field of exploration; its sameness, the dreary tameness of the bulk of the continent, the comparative paucity and low state of the aborigines, deprive an explorer's narrative of many of the points of interest to be met with in the case of other countries—Africa, for example, South America, or even the Arctic regions. Still this little book shows that during the comparatively brief period that Australia has been a field for exploration, there have been plenty of deeds of daring and determination and self-sacrifice in the cause of scientific knowledge, to render any skilfully

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written narrative of Australian discovery interesting. Mr. Eden has told the story attractively, and the reader will not only be greatly interested, but will have a fair idea of what has been done to extend our knowledge of the "fifth continent" from its first discovery down to the trans-continental journeys of Warburton and Forrest—the latter, however, being referred to in a sentence or two.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*]

Dr. Bastian and Prof. Tyndall on Spontaneous Generation

I BEG you to allow me a few lines to protest, as Prof. Tyndall has done elsewhere, against Dr. Bastian's proceeding, in citing a number of observers *in support* of his views (NATURE, vol. xiii. p. 284), whose researches taken in each case—as a whole—furnish conclusive arguments *against* his views.

It is only by an inadequate statement that the observations of Dr. Pode and myself—which appear in Dr. Bastian's list—can have this signification attached to them. Where we obtained the result which Dr. Bastian obtained, we were able to trace it to a vitiation of the experimental conditions. Our results conclusively and categorically contradicted the particular assertions contained in Dr. Bastian's book, the "Beginnings of Life," into the truth of which we set ourselves to inquire.

Feb. 16 E. RAY LANKESTER

Radiometers and Radiometers

I HAVE recently been trying some experiments with a radiometer, obtained from Mr. Browning, and as some of my results are different from what I was led to anticipate, I should like to know whether there is anything special in my particular instrument, or whether other people have noticed the same things.

In Mr. Crookes' paper on "The Mechanical Action of Light," *Quarterly Journal of Science*, No. xlvii. p. 348, he states that "when only dark heat is allowed to fall on the arms [of the radiometer], as from a vessel of boiling water, *no rotation whatever is produced*." (The italics are mine.)

Now I find that my radiometer is particularly sensitive to dark heat, the presence of a heated copper wire, or still more that of an iron poker when only slightly warmed, instantly accelerating the number of revolutions.

But more than this: when exposed in a room to diffused daylight, the velocity of rotation is greatly influenced by the temperature of the room, and is by no means an indicator of the amount of light only.

One morning this week during the frost, upon looking at my radiometer, it appeared to be motionless, although standing not far from my study window. When placed nearer to the light it revolved, but so slowly that I thought the instrument must have received an injury. The room at the time was very cold, as the fire had not been lighted. After the fire had been lighted and the temperature of the room raised, the velocity of rotation increased, and upon observing the instrument just before dark, when the room was very warm, the rotation was considerably greater than it had been in the window in the middle of the day, although at the time there was only just enough light in the room to enable me to see the instrument at all. When I brought the radiometer near to the fire, which consisted only of dull hardly glowing coals, the rotation of the arms became so rapid as to render them almost invisible.

Upon taking the instrument out of doors between five and six o'clock in the afternoon, the thermometer a few degrees below freezing-point, the arms revolved slowly from right to left as usual, but upon bringing it near to a mass of snow, and shading the light off by some pieces of wood, I could see that the arms revolved slowly in the opposite direction, that is, in the same direction as the hands of a watch. Later in the evening I held the instrument in the open air in bright moonlight, the thermometer being at 24° F., and the rotation was again in the same direction as the hands of a watch. The next morning, when the temperature was nearly the same, but the air foggy with only feeble light, the arms revolved at about the same rate but in the usual direction, from right to left. In the evening I again held the radiometer in the moonlight in the cold frosty air; the rotation was as before, from left to right. Carrying the instrument in my hand I approached the house, the hall door of which stood open. As I came within reach of the light and heat the rotation diminished, and at length ceased, but upon entering the hall it commenced again, only in the opposite direction. In fact, I could stand in such a position that upon moving a few feet either way, I reversed the direction of rotation, while between the two there was no motion at all.

I afterwards repeated the experiment in a different form. I placed the instrument in a cupboard in a very cold room, with a considerable quantity of ice. Upon just opening the cupboard door and peeping in, I could see that the arms were revolving very slowly, but distinctly, from left to right. Upon opening the door a little wider the motion ceased, and when still more light was admitted the motion was reversed. I then removed the ice and nearly closed the door—the rotation ceased entirely; but upon introducing a piece of heated iron the arms spun round as fast as they usually do in full sunlight, and this, be it remembered, when the cupboard was almost dark, the door being only just sufficiently open for me to see the instrument, certainly not more than a quarter of an inch. T. N. HUTCHINSON

Rugby, Feb. 12

Since writing the above, I have been favoured with a note from Mr. Crookes, in which he points out to me that his results have been obtained by means of radiometers constructed with *pith* discs, and having no metal at all in the moving parts. In the little instrument that I have used the discs are of mica, blackened, of course, on the alternate faces, but mounted upon four metallic arms, apparently aluminium foil. Mr. Crookes observes: "I long ago gave up metallic instruments owing to their erratic movements while radiating or absorbing heat. I have mentioned this peculiarity of metallic radiometers in my papers for the Royal Society."

As this difference between the instruments used accounted, to some extent, for my obtaining results so different from those described by Mr. Crookes in the paper referred to, I felt at first that there was no further need to trouble you with these remarks, and that they had better be consigned to the waste paper basket. Upon second thoughts, however, it seems to me that there is still something that requires explanation, or, at all events, that I do not understand, in the different action of dark heat on pith only, and on mica mounted on thin metallic arms. The four arms are very fine, equally bright, and similar in all respects, hence it is difficult to see how rotation should be produced by the action of heat on the metallic parts of the apparatus. The vacuum, no doubt, is not so perfect as that obtained by Mr. Crookes with his exquisite Sprengel pump, but even this would hardly account for the "erratic movements" that I have observed.

I may add that since performing my experiments I have learnt that one of my pupils in Rugby School, Mr. H. F. Newall, has observed very similar results with a radiometer in his possession. T. N. H.

The Sailing Flight of Birds

HAVING had during several long voyages in the Pacific considerable opportunities for observing closely the flight of sailing birds, and especially of *Diomedea Melanophrys*, or "Mutton Bird," as I believe it is called by the Australians, a few suggestions on the subject may perhaps not be uninteresting to your readers.

This bird differs considerably in size from the albatross of the Cape, but as the principles of its flight are the same, the few suggestions I wish to make will apply with equal force to both species, and indeed to all sailing birds.

The *Diomedea* of the Cape it is well known can support itself in the air for a very long time without flapping its wings, and in "The Reign of Law" it is stated that "sometimes for a whole hour together this splendid bird will sail or wheel round a ship in every possible variety of direction, without requiring a single stroke of its pinions." This *may* be accurately true, but in the case of the smaller albatross I refer to, between one and two minutes, or perhaps 1,000 or 2,000 yards in space, is more approximately the limit to which the bird's power of sailing is exercised. When the flight begins after rest the bird appears to feel very considerable difficulty in rising from the sea. It runs along the surface for some distance, flaps its wings very vigorously, and continues to do this after it has left the water, until it acquires a

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